

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (withdrawn): A method of manufacturing an actuator device comprising the steps of:
forming a vibration plate on one surface of a substrate; and
forming a piezoelectric element having a lower electrode, a piezoelectric layer, and an upper electrode on the vibration plate,

wherein the step of forming a vibration plate at least includes an insulation film forming step of forming an insulation film made of zirconium oxide by forming a zirconium layer above the one surface side of the substrate in accordance with a sputtering method and subjecting the zirconium layer to thermal oxidation by inserting the substrate formed with the zirconium layer to a thermal oxidation furnace heated to a temperature greater than or equal to 700°C at a speed greater than or equal to 200 mm/min.

2. (withdrawn): The method of manufacturing an actuator device according to claim 1, wherein the temperature for heating the thermal oxidation furnace is set in a range from 850°C to 1000°C.

3. (withdrawn): The method of manufacturing an actuator device according to claim 1, wherein a rate of temperature increase of the zirconium layer upon insertion of the substrate into the thermal oxidation furnace is set greater than or equal to 300°C/min.

4. (withdrawn): The method of manufacturing an actuator device according to claim 3, wherein a density of the insulation film is set greater than or equal to 5.0 g/cm³ in the insulation film forming step.

5. (withdrawn): The method of manufacturing an actuator device according to claim 4,

wherein a film thickness of the insulation film is set greater than or equal to 40 nm in the step of forming the insulation film.

6. (currently amended): A method of manufacturing an actuator device comprising ~~the steps of:~~

forming a vibration plate above one surface of a substrate; and

forming a piezoelectric element ~~having comprising~~ a lower electrode, a piezoelectric layer, and an upper electrode above the vibration plate,

wherein the ~~step of forming the vibration plate at least includes the steps of~~ comprises:

forming an insulation film ~~made of comprising~~ zirconium oxide by forming a zirconium layer above the one surface ~~side~~ of the substrate and subjecting the zirconium layer to thermal oxidation while heating the zirconium layer up to a predetermined temperature at a predetermined rate of temperature increase[~~;~~]; and

adjusting stress of the insulation film by annealing the insulation film at a temperature less than or equal to a maximum temperature in the thermal oxidation of the zirconium layer.

7. (currently amended): The method of manufacturing an actuator device according to claim 6,

wherein the rate of the temperature increase upon the thermal oxidation of the zirconium layer is set greater than or equal to 5°C/sec.

8. (currently amended): The method of manufacturing an actuator device according to claim 7,

wherein the rate of the temperature increase upon the thermal oxidation of the zirconium layer is set greater than or equal to 50°C/sec.

9. (currently amended): The method of manufacturing an actuator device according to claim 8,

wherein the zirconium layer is heated by ~~an~~ a rapid thermal annealing (RTA) method upon the thermal oxidation of the zirconium layer.

10. (currently amended): The method of manufacturing an actuator device according to claim 7,

wherein a density of the insulation film is set greater than or equal to 5.0 g/cm^3 in the ~~step of~~ forming the insulation film.

11. (currently amended): The method of manufacturing an actuator device according to claim 10,

wherein a film thickness of the insulation film is set greater than or equal to 40 nm in the ~~step of~~ forming the insulation film.

12. (currently amended): The method of manufacturing an actuator device according to claim 6,

wherein a temperature upon the thermal oxidation of the zirconium layer is set in a range from 800°C to 1000°C .

13. (currently amended): The method of manufacturing an actuator device according to claim 12,

wherein a temperature upon the annealing the insulation film is set in a range from 800°C to 900°C .

14. (currently amended): The method of manufacturing an actuator device according to claim 13,

wherein a time period for the annealing the insulation film is adjusted in a range from 0.5 hours to 2 hours.

15. (withdrawn): The method of manufacturing an actuator device according to claim 1,

wherein the step of forming the vibration plate comprises the step of forming an elastic film made of silicon oxide (SiO_2) above the one surface of the substrate made of a single crystal silicon substrate, and

the insulation film is formed above the elastic film.

16. (withdrawn): The method of manufacturing an actuator device according to claim 1,

wherein the step of forming the piezoelectric element at least comprises the step of forming the piezoelectric layer made of lead zirconate titanate (PZT) above the vibration plate.

17. (original): A liquid-jet apparatus, comprising:

a liquid-jet head applying the actuator device manufactured by the method according to any one of claims 1 to 16 as liquid ejecting means.